(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 334 485**
A3

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: **89301621.2**

(22) Date of filing: **20.02.89**

(51) Int. Cl.[4]: **G 05 D 1/08**
B 64 G 1/26

(30) Priority: **29.02.88 US 161931**

(43) Date of publication of application:
27.09.89 Bulletin 89/39

(84) Designated Contracting States: **DE FR GB**

(88) Date of deferred publication of search report:
04.10.89 Bulletin 89/40

(71) Applicant: **FORD AEROSPACE CORPORATION**
300 Renaissance Centre
Detroit Michigan 48243 (US)

(72) Inventor: **Garg, Subhash C.**
1789 Trudean Way
San Hose California 95132 (US)

Bhat, Mahabaleshwar K. P.
1196 Lynbrook Way
San Jose California 95129 (US)

(74) Representative: **Crawford, Andrew Birkby et al**
A.A. THORNTON & CO. Northumberland House 303-306
High Holborn
London WC1V 7LE (GB)

(54) **Spacecraft attitude control using coupled thrusters.**

(57) An attitude control system for a three-axis controlled spacecraft (1) in which the location of thrusters causes significant cross-coupling torques. A thruster command conditioning electronics module (TCCEM) (3) is positioned between the conventional roll, pitch, and yaw loop controllers (41-43) and the thrusters (61-63). The TCCEM (3) converts spacecraft-axis-based torque requirement signals (TDX, TDY, TDZ) emanating from the loop controllers (41-43) into scalar quantities (UL, UM, UN) that are input to thruster modulators (51-53) that turn on one or more thrusters of the thruster pairs (L,M,N). The TCCEM (3) causes the spacecraft (1) attitude to be adjusted as commanded by the torque requirement signals (TDX, TDY, TDZ) despite the presence of the cross-coupling. Two embodiments are illustrated: a working embodiment in which cross-coupling torques are produced about two axes (Y,Z), and a more general embodiment in which cross-coupling torques are present about all three axes (X,Y,Z).

EP 0 334 485 A3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 89 30 1621

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
Y	EP-A-0 148 550 (FORD AEROSPACE & COMMUNICATIONS) * abstract; page 5, lines 6 - page 5a, line 10; page 8; line 15-page 9, line 9; page 10, line 19 - page 11, line 15; page 13, line 29 - page 14, line 7; claims 4, 9, figures 1,2 *	1-3,6,9	G 05 D 1/08 B 64 G 1/26
A	---	5	
Y	JOURNAL OF GUIDANCE AND CONTROL vol. 3, no. 3, May-June 1980, pages 195-202, New York, US; K.L. LEBSOCK: "High Pointing Accuracy with a Momentum Bias Attitude Control System". * chapters "Introduction","Disturbance Torque Model","Momentum Resolution", figures 1,6 *	1-3,6,9	
A	idem	5,10,7	

Y	EP-A-0 071 445 (FORD AEROSPACE & COMMUNICATIONS) * page 7, line 1 - page 9, line 3; figures 1,2 *	1-3	TECHNICAL FIELDS SEARCHED (Int. Cl.4)
	---		G 05 D 1/00 B 64 G 1/00
A	US-A-3 866 025 (CAVANAGH) * column 1, lines 17-47; column 2, line 40 - column 3, line 10; column 4, lines 17-67; column 5, line 47 - column 6, line 32; column 7, line 41 - column 8, line 7; column 11, line 18 - column 15, line 29; figures 1,3 *	1-4	

A	GB-A-1 514 745 (RCA CORPORATION) * page 1, lines 18-71; page 2, lines 25-92; figure 1 *	1	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	05-06-1989	BEITNER M.J.J.B.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P0401)